2010 Yearly Report for Predicting climate change threats to key estuarine habitats and ecosystem services in the Pacific Northwest – PI: Deborah Reusser, Ph.D.

In December 2009, a workshop sponsored by USGS and EPA was held to identify on-going sea level rise (SLR) modeling efforts, data gaps, and information needs for management decisions about current and future mitigation and restoration efforts in Oregon estuaries. The workshop brought together 46 NGO's, Federal scientists, state land managers, and SLR modelers and has inspired collaborations for data, knowledge and technology exchange. We have scheduled a second SLR modeling workshop for Feb. 1 & 2, 2011 in Newport, OR to continue to build upon the collaborative efforts established at the first workshop.

Throughout 2010, PI's, partners and researchers have presented on-going climate change research results at conferences. A complete list of peer reviewed abstracts is given on page 3.

In 2010 a detailed evaluation of the Sea Level Affects Marshes Model (SLAMM) was conducted to understand and document the methodology. Activities included preparing input parameters for project areas, documenting derivations, requirements, best-uses and limitations. Uncertainty and sensitivity analyses were conducted for habitat change projections using 6 scales of digital elevation models (DEMs). Findings from this evaluation are scheduled to be presented at three professional conferences in 2011 and a manuscript is in progress. Outputs from SLAMM model runs 2000-2100 were provided to the Forest Service for evaluation of loss/gain in salmon habitat through 2100 in Poole Slough.

Deborah Reusser (USGS), Cheryl Brown (USEPA) and Henry Lee II (USEPA) were invited to contribute, and are authors on Chapter six of the State of Oregon Climate Assessment Report produced by OCCRI entitled, *Impacts of climate change on Oregon's coasts and estuaries*.

Collaborative meetings are held frequently to discuss on-going climate change research activities including analyzing sea surface temperature (SST) patterns in nearshore ecosystems, model development for submerged aquatic vegetation (SAV) and SLR. Data for the nearshore SST analyses are now available to the public through NBII. An open file report describing the data has been submitted to the EPN for publishing, and a manuscript on the ecoregional nearshore patterns of SST is in internal review. In April and Nov. 2010 USGS was invited to present detailed information on current research activities to state, regional and local stake holders in Oregon. In addition, specialized GIS techniques for preparing data for SLR modeling have been made available for our partners and presented to the local GIS user group.

Downscaled data is being provided to us from OCCRI to model changes in temperature and salinity within Oregon estuaries. IN 2010 OCCRI developed a code framework to allow climate data from the North American Regional Climate Change Assessment Program (NARCCAP) to be applied to the study of estuaries in the Pacific Northwest. The NARCCAP project provides high resolution (50 km grid cells; 3 hourly or daily timestep) climate data using state of the art global and regional climate models. The NARCCAP domain covers most of the continent of North America. Both "reference" (i.e. historical) and future data sets are available. Data is served from the NARCCAP web site in the form of netCDF files.

The code developed at OCCRI for this project allows researchers to specify a subdomain (or subdomains), and extract the climate parameters of interest from the NARCCAP data set. Statistical processing of the climate parameters (e.g. a domain mean) has also been developed. For this project, 5 subdomains and 7 climate parameters are included. Each subdomain/parameter pairing will be run for each of 7 different climate "scenarios" (i.e. a particular global/regional model pairing).

Code development is complete, and the project is in the final Quality Assurance phase. Preliminary test deliveries of subsets of the data have been completed. Final deliveries are anticipated to occur before the end of January 2011. Data will be made available from the OCCRI website in the future but currently is available upon request.

The USEPA has performed simulations examining the effect of rising sea level (30 and 60 cm rise) on water temperature and salinity in the Yaquina Estuary. Simulations demonstrate that the interaction of changes in river discharge, rising sea level, and atmospheric temperature associated with climate change produce non-linear patterns in the response of estuarine salinity and temperature, which vary with season and location inside the estuary.

USDA-ARS researchers have put together high resolution ARC-GIS layers for intertidal bathymetry and distance to mouth as well as eelgrass, burrowing shrimp and oyster aquaculture habitats in Willapa Bay, Washington for this project. We await results of bathtub modeling exercise and climate scenario projections to integrate and validate models to examine effects of SLR and temperature and salinity changes on these habitats and engineering species. We have also assembled a historical layer representing native oyster (*Ostrea lurida*) habitat in Willapa Bay and are in the process of assembling data for oyster aquaculture and potential native oyster habitats in Coos Bay, Yaquina Bay, and Netarts estuaries in Oregon.

US Forest Service is exploring potential changes in salmon habitat configuration, location, and quantity as part of ongoing work to generate predictions of changes in estuarine vegetation as a result of sea-level rise using SLAMM model outputs from USGS researchers.

Preliminary work has focused on Poole Slough, a small slough contained within the larger Yaquina Bay Estuary. Poole Slough has offered us the opportunity to refine analysis and determine questions of interest with regard to salmonid habitat. Five SLAMM predictions for Poole Slough were made available to the Forest Service for this assessment (for years 2000, 2025, 2050, 2075, and 2100). The available area of estuarine habitat in each prediction was overlaid with the current habitat distributions for Chinook, coho, and steelhead trout.

Between 2000 and 2025, it was found that estuarine habitats migrated upstream by approximately 0.61 km. Further inundation freshwater stream habitat did not occur in later SLAMM predictions. By inundating approximately 0.61 km of upstream freshwater habitat between 2000 and 2025, the Forest Service predicts a decrease in the available spawning habitat of Chinook salmon. The loss of spawning habitat for Chinook is of concern. While approximately 4.4 km of spawning habitat will remain in the basin, the loss of 0.61 km represents a decrease of approximately 15% of the spawning habitat in the system which cannot be compensated for by the expansion of the estuary margin due to the high levels of salinity which would kill incubating eggs.

The Forest Service is planning to expand this analysis to other estuaries on the Oregon coast as the SLAMM predictions become available from USGS. The work done in Poole Slough will be included in a larger comparison to patterns of fish habitat in the Yaquina Estuary and may offer insights into differences in habitat that would be expected at differing spatial extents.

Products and deliverables

Dec 2009 SLAMM Modeling workshop, Newport, OR.

List of Abstracts for Presentations/Posters:

Frazier, M., Lee II, H., Reusser, D.A., Nelson, W., Dutch, M., Welch, K. 2010. Evaluating a method of assessing coastal condition using benthic organisms. 2010 GEO Beijing, Ministerial Summit, Beijing, China, Nov. 15, 2010.

Lee II, H., Brown, C.A., Janousek, C., Clinton, P.J., Young, D.R., Reusser, D.A., and Loiselle, R. 2010. Keeping your seed head above water – EPA's research on the effects of sea level rise on sea grasses and emergent marshes in the Pacific Northwest. Coastal Wetlands Data and Information Workshop. Newport, OR. April 19-20, 2010.

Lee II, H., and Reusser, D.A. 2010. Using biogeographic distributions and natural history to predict marine/estuarine species at risk to climate change. American Physiological Society Intersociety Meeting: Global Change and Global Science: Comparative Physiology in a Changing World. Westminster, CO. August 4-7, 2010.

Loiselle, R., Reusser, D.A., Lee II, H., and Frazier, M. 2010. Shifting trends of temperature and biodiversity in the Eastern Bering Sea. USGS Climate Change Conference, Denver, Colorado. March 9-11, 2010.

Loiselle, R., Reusser, D.A., Lee II, H., Brown, C.A., Clinton, P., and Janousek, C. 2010. SLAMM Modeling of Yaquina Estuary, Central Oregon Coast. Oregon Climate Change Research Institute's (OCCRI) PNW Climate Science Conference, Portland, OR. June 15-16, 2010.

Payne, M. C., D. A. Reusser, H. Lee II, and C. A. Brown (2010), A remote-sensing/GIS application for analysis of sea surface temperature off the western coast of North America, (abstract & poster), presented at AGU Ocean Sciences Meeting 2010, Portland, Oregon, February 22-26, 2010.

Payne, M.C, Reusser, D.A., Lee II, H., Brown, C.A., and Frazier, M. 2010. Analysis of near shore sea surface temperatures in the Northern Pacific. USGS Climate Change Conference, Denver, Colorado. March 9-11, 2010.

Payne, M. C., D. A. Reusser, H. Lee II, and C. A. Brown (2010), Remotely-Sensed Sea Surface Temperature (SST) of the Northern Pacific Coastal Zones, (abstract & presentation), presented at Pacific Northwest Climate Science Conference (OCCRI), Portland, OR, June 15-16 2010.

Payne, M. C., D. A. Reusser, H. Lee II, and C. A. Brown (2010), Remotely-Sensed Nearshore SSTs of the Northeast Pacific, (abstract & poster), presented at ClimECO2: Oceans, Marine Ecosystems, and Society facing Climate Change - A multidisciplinary approach - An international Summer School co-organized by IUEM, IMBER and Europôle Mer, Brest, France, August 23-27 2010.

Saarinen, J. A.. "Development of the best available seamless intertidal DEM from multiple sources for the Yaquina River estuary." Presented, Central Coast GIS User's Group, Newport, Oregon, November 10, 2010.

Journal Articles & Reports:

Payne, M. C., D. A. Reusser, C. A. Brown, H. Lee II, and (2010 (in progress)), Ecoregional analysis of near-coastal sea-surface temperature in the North Pacific, for submission to: *Global Ecology and Biogeography*.

Payne, M. C., D. A. Reusser, H. Lee II, and C. A. Brown (2010), Moderate-Resolution sea surface temperature data for the Nearshore North Pacific, USGS Open File Report 2010-1251, html.

Ruggiero, P., Brown, C.A., Komar, P.D., Allan, J.A., Reusser, D.A., and Lee II, H. (2010) Chapter 6: Impacts of climate change on Oregon's coasts and estuaries. In: Oregon Climate Change Research Institute (2010), Oregon Climate Assessment Report, K.D. Dello and P.W. Mote (eds). College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, OR. available at: www.occri.net/OCAR.